ADDENDUM NO. 1

91C Sensitive RF Voltmeter

for 220 V, 50 Hz Models

J. PRUSHA

BOONTON ELECTRONICS CORPORATION

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for 220 V, 50 Hz Models

Some models are designed to operate from a primary power source of 50 Hz and 220 V, as indicated on the serial name plate of the instrument.

The following component values are changed in the 220 V, 50 Hz models:

1. Power Transformer, T1 changed to 220 V primary.
2. Capacitor 0.5 µf added in shunt with C119.
3. Fuse F101 0.5A becomes 0.25A.

Reference	Description	Part Number
T1	220 V Power Transformer	446015
C32	0.5 µf 20%	230135 (added)
F1	Fuse 0.25A MDL SB	545511

Instruction Book
MODEL 91C
RF Voltmeter

For Serial Numbers 6269 and above

BOONTON ELECTRONICS CORPORATION

ROUTE 287 AT SMITH ROAD
PARSIPPANY, N. J.— 07054

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SECTION I

MODEL 91 C

SPECIFICATIONS

1.1	Measurement Range:	1 millivolt to 3 volts
1.2	Full Scale Ranges:	.001, .003, .01, .03, .1, .3, 1, 3 volts
1.3	Frequency Range:	20 Kc to 1200 Mc*
1.4	Accuracy:	5% of full scale to 400 Mc 10% of full scale above 400 Mc
1.5	Input Impedance:	91-12E RF Probe See curve for shunt resistance data on high impedance probe. Shunt capacitance varies inversely with input voltage from 1.5 to 3pf. 91-8B 50Ω BNC Adapter Max. VSWR 1.2 up to 600 MC. 91-13A Probe Tip For direct measurements up to 250 MC.
1.6	Tube Complement:	1 each: BEC 525001, 7199, 6AU6, OA2, and 6X4.
1.7	Power Requirements:	105-125 volts, 58-62 ∿ 30 watts.
1.8	Dimensions:	7-1/9 W, x 9-1/2 D, x 11 H excluding handle
1.9	Weight:	12 pounds

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*For measurements in this region use of the 91-14 "Tee" Adapter and 91-15A 50Ω Termination is strongly recommended. See page 2

SECTION II

GENERAL DESCRIPTION

The 91C RF Voltmeter is a sensitive instrument for the measurement of voltages of 1 millivolt to 3 volts spanning a wide frequency range of 20 kilocycles to 1200 megacycles. In addition to conveniently measuring voltage levels in a diversity of rf circuits, the instrument has application for many associated tests. Such measurements include: the frequency response of both active and passive networks, i.e., amplifiers and filters; VSWR and return loss on transmission lines and attendant systems; attenuation and insertion loss of rf attenuators; and high frequency parameters of transistors. With true rms response below 0.03 volt (up to 3 volts with the 91-7C, 100:1 divider), wide band noise can be measured, and using suitable null networks measurement of the harmonic distortion of RF waveforms can be performed without the attendant errors of average type meters.

The instrument is also useful as an rf null detector for bridge measurements and analogous techniques when a sensitivity in the order of 300 microvolts will suffice.

Supplied with each instrument is a general purpose probe, 50 ohm adapter, and probe tip. The adapter is fitted with a BNC coaxial connector and provides a 50 ohm termination with a low VSWR up to at least 600 megacycles. The probe tip and companion ground clip are useful for direct measurement to approximately 100 megacycles. Above 100 megacycles, the probe may be used directly without the tip or ground clip, but the connecting leads must be extremely short to avoid resonant effects. In the special case where it is possible to connect the probe <u>directly</u> to the voltage source, the specified tolerance is maintained to at least 1200 megacycles. The impracticability of such a connection, however, precludes our assuring the accuracy of the 91C RF Voltmeter above 250 megacycles without the use of the following accessories: The 91-8B 50Ω Adapter should be used for measurements to 600 Mc and the 91-14A Tee Adapter with 91-15A 50Ω Termination for measurements to 1200 Mc.

The 91-12E probe with its full-wave crystal detecting circuit produces a true rms response without turnover, or harmonic errors for all voltage levels below 0.03 volt, gradually changing to peak-to-peak reading (calibrated in rms) at approximately 1.0 volt. The probe has a shunt capacitance of approximately 2.5 μμf at levels of 0.3 volt or higher, increasing slightly at levels of 0.1 volt or less. The shunt resistance component shown in Figure 1 is a variable factor, depending on the voltage and frequency.

Figure 1 also shows the input resistance of the 91-7C, 100:1 Voltage Divider When the frequency and the voltage to be measured permit, consideration should be given to the use of the 91-7C. In addition to extending the voltage range of the instrument to 300 volts, the benefit is threefold: the input resistance is increased above that available with vacuum tube diode probes, and the diode overload protection as well as the range of true rms response is increased by a factor of 100. The 100:1 divider may be used at frequencies up to 700 megacycles with negligible loading for most rf circuitry.

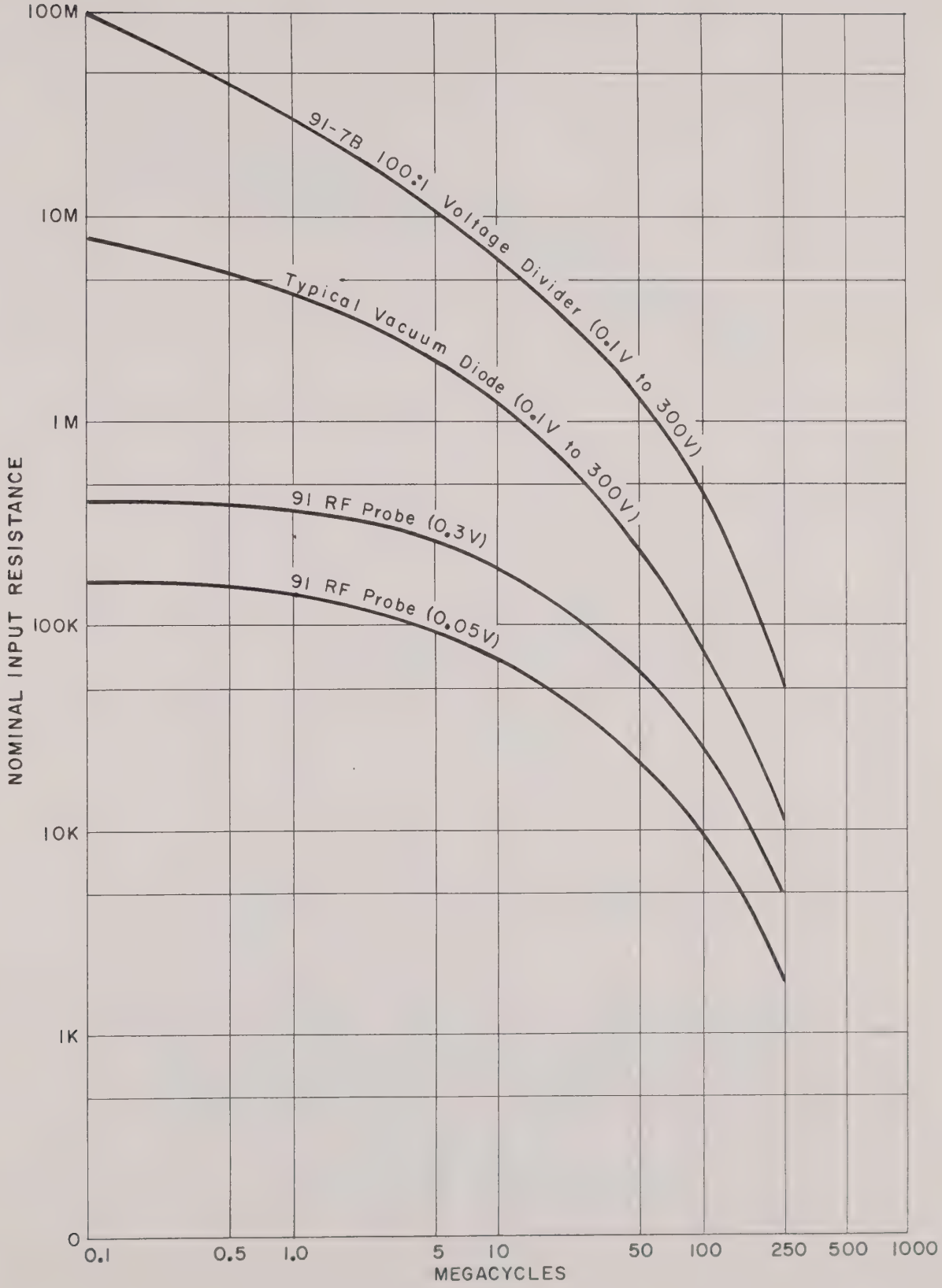
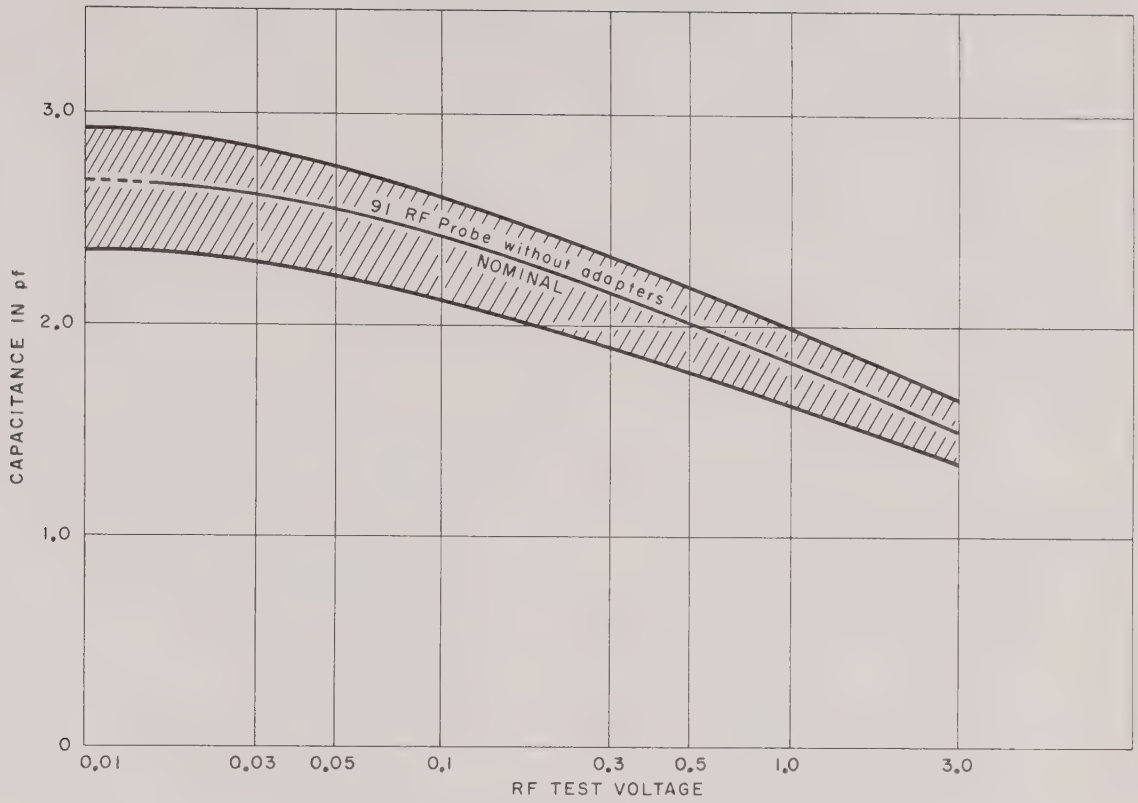
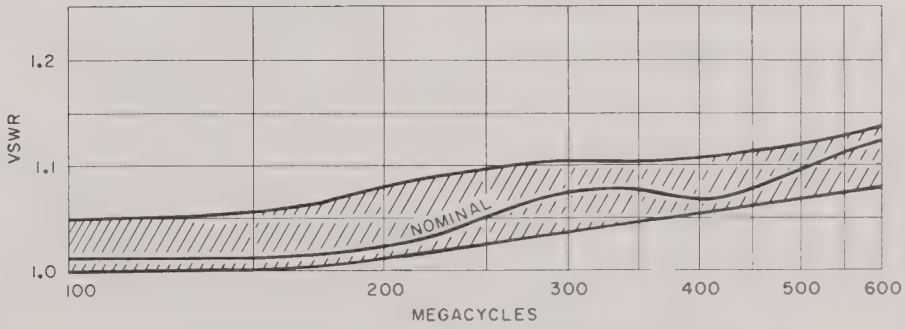

100M
10M
1M
100K
10K
1K
0
NOMINAL INPUT RESISTANCE
91-7B 100:1 Voltage Divider (0.1V to 300V)
Typical Vacuum Diode (0.1V to 300V)
91 RF Probe (0.3V)
91 RF Probe (0.05V)
0.1
0.5
1.0
5
10
50
100
250
500
1000
MEGACYCLES

Fig 1a



INPUT CAPACITANCE vs TEST LEVEL
(measured at 10 Mc)

Fig 1b



TYPICAL VSWR OF 91-3B RF PROBE
with 91-8B 50Ω Adapter

Fig. 1c

SECTION III

OPERATING PROCEDURE

3.1 General

3.2 This section describes in detail the operating procedure for the 91C RF Voltmeter. All information required for safe and proper operation of the instrument is included. Be sure to read this section before placing the instrument into operation.

3.3 Initial Turn-On Procedure and Tests

3.4 Tests To perform the initial tests proceed as follows:

a. After unpacking the unit, and before plugging it into an ac outlet for the first time, turn the instrument back and forth several times to make sure the tubes have not fallen from their sockets due to rough handling.

b. Observe the meter pointer to see that it moves freely and rests at zero when the instrument is steady.

c. If the pointer rests to the right or left of zero, set it at zero with the zero set screw.

CAUTION

Before plugging the instrument into the convenience outlet, make sure the power supply is 105-125 volts ac, 55-65 ∿, unless otherwise specified on nameplate.

3.5 Turn-On Procedure. To perform the initial turn-on procedure proceed as follows:

a. Plug the instrument into the power source.

b. Set the toggle switch to ON (up), and allow a warm-up period of approximately one minute.

c. Connect probe cable assembly to the instrument at jack marked PROBE. Check serial number of probe and see that it is the same as that of the voltmeter.

d. Check meter deflection on all ranges with probe tip shorted to probe case ground. Normal meter deflections are as follows:

RANGE	DEFLECTION
.003	less than 1/8 inch
.01, .03, .1, .3, 1	Zero
3	Suppressed

3.6 Measurement Procedure

a. Set RANGE-FULL SCALE control to appropriate setting (or higher) for voltage to be measured.

b. Connect probe ground clip to ground point of voltage source under test. This connection must be as short and direct as possible to minimize errors arising from circulating RF currents in the ground return impedance.

c. Connect probe tip to high point of voltage source under test. This connection must also be as short as possible to minimize resonance rise effects at frequencies above 100 megacycles.

d. Read RF voltage on appropriate meter scale corresponding to setting of RANGE-FULL SCALE control.

e. To obtain relative level readings in decibels add the DB (red scale) meter reading to the DB (red)setting of the RANGE-FULL SCALE control. Although individual DB readings have no significance as measured on the 91 type RF Voltmeter, the difference between two DB readings represents the actual change in level on a decibel basis. When used with a good signal generator, the DB scale greatly facilitates the measurement of relative attenuation and bandpass characteristics of networks.

f. As it is frequently desired to measure RF voltages in coaxial systems the Model 91 is provided with a 50Ω coaxial adapter having a low VSWR up to 600 MC.

3.7 Operating Precautions

3.8 Maximum Input Voltages

RF voltages exceeding 10 volts must not be applied to the probe or permanent damage to the crystal diodes may result. The 50Ω adapter should not be subjected to continuous overloads exceeding 10 volts to avoid excessive heating of terminating resistor.

Maximum DC voltage for RF probe is 300 volts.
Maximum DC voltage for 50Ω adapter is 10 volts.

Note: Do not apply maximum DC voltage simultaneously with maximum RF voltage when using 50Ω adapter

3.9 Temperature Effects

The normal ambient temperature range for specified accuracy is 65° to 90° F. Appreciable inaccuracies can be expected while the probe is exposed to temperatures above or below this range. No permanent change in probe characteristics will result from the high or low temperature exposure.

Inaccuracies due to temperature effects may occur after soldering to the probe tip or from heat sources such as resistors or tubes.

When making low level measurements in the order of 2 millivolts or less, it is important to make sure that the probe has attained a uniform temperature throughout. A temperature difference between the inside and outside of the probe can generate a small thermal voltage that may add to or subtract from the DC voltage generated by the diodes.

3.10 Hum, Noise, and Spurious Pick-up

When measuring low level RF voltages, precautions should always be taken to avoid the possibility of erroneous readings resulting from hum, noise, or stray RF pick-up. Although all low frequency hum and noise is attenuated at the input by 60 db, it is still possible for high level unwanted signals to get through and cause errors. The best test for this condition is to reduce the test signal to zero level and note whether the voltmeter continues to read some spurious signal level. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray field pick-up. Typical sources of spurious radiation are induction or dielectric heating units, diathermy machines, local radio transmitters, grid dip meters, and amplifiers with parasitic oscillatons.

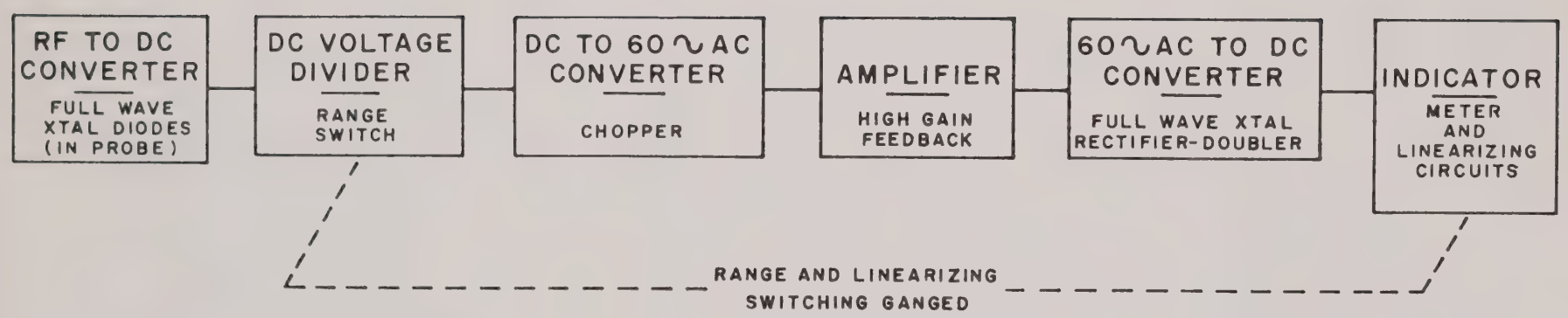
SECTION IV

THEORY OF OPERATION

An understanding of the operating features of the Model 91 Sensitive RF Voltmeter may be obtained by a study of the block diagram (Fig. 2) in conjunction with the following description.

The radio frequency voltage to be measured is rectified in the RF Probe by means of a full wave germanium diode rectifier circuit. The resulting DC potential is then attenuated as required before conversion to 60 ∿ AC by the chopper. This AC signal is then amplified in a narrow band feed-back stabilized amplifier prior to its re-conversion to DC for use in actuating the meter.

The germanium diodes used in the RF Probe have been carefully selected for several characteristics. As the selected diodes do not all exhibit the same rectification efficiency characteristics, it becomes necessary to adjust each meter range to match individual probe diodes. The range adjustments consist of individual non-linear circuits shunting the output meter circuitry. As the RANGE switch is set to the required test voltage position the appropriate non-linear adjusting circuit is automatically shunted across the output. It is also important to understand that the non-linear output circuitry is designed to compensate for the non-linear characteristics of the probe diodes when operating at levels below 0.3 volt.



BLOCK DIAGRAM

TYPE 91, RF VOLTMETER

Figure 2

(A830,071A)

SECTION V

MAINTENANCE

5.1 Periodic Checking

The Model 91C Voltmeter is designed to give long periods of service without maintenance when operated in accordance with these instructions. It is recommended, however, that the instrument be checked occasionally using reliable standards to insure against errors resulting from deterioration of tubes or chopper. To make these checks, it is necessary to have a signal source in the 200 to 500 KC region with less than 2% distortion at levels up to 3 volts across 50Ω. A precision electronic voltmeter of the averaging response type, such as the Ballantine Model 310A or 314, Hewlett Packard Model 400D or 400H, may be used to monitor the signal source for this purpose. To insure its accuracy, the monitoring meter should be checked at some low frequency (50-100 ∿) of good waveform against a dynamometer type AC meter of at least 1% accuracy.

5.2 Calibration Precautions

When attempting to check the voltage calibration accuracy on an instrument having the sensitivity and bandwidth of the Model 91C, it is essential to take precautions to avoid errors resulting from stray pick-up voltages. (See paragraph 3.10). A well shielded signal source must be used in conjunction with coaxial connections to both the Model 91C and the standard reference meter. Even with a well shielded generator and associated connections, it is sometimes possible for the reference meter to pick up stray RF signals and feed them into the probe. Check for this condition by disconnecting standard meter and noting change in level.

5.3 Calibration Check Procedure

With suitable calibrating equipment (paragraph 5.1) and taking necessary precautions (paragraph 5.2), we can now check the Model 91C for calibration accuracy. Each range should be checked at a voltage representing 90% of full scale value. If these check points agree within ± 2% of the standard, it is recommended that no adjustment be made. If the check points deviate by more than ± 5% from the standard, it is recommended that a trouble shooting procedure be followed as outlined in paragraph 5.4. If the check points fall between 2% and 5% of the standard, the calibration adjustment procedure as outlined in paragraph 5.5 should be followed.

5.4 Trouble Shooting Procedure

a. Case Removal

The instrument may be removed from its case after first removing the two screws located at the back of the case (near the bottom) and the four screws located on the sides of the case near the front.

The power supply may be removed from the case after first removing the four screws located on the sides of the case near the rear.

b. Tube Replacement

If the tube V1 should become weak or noisy, it should be replaced with BEC 525001 or a commercial low noise 12AX7 which has low microphonism and meets the requirements of paragraph 3.5d above. The Telefunken ECC83/12AX7 has been found to meet these requirements consistantly. After replacing defective tubes, re-check calibration as outlined in paragraph 5.3 and adjust, if necessary, as described in paragraph 5.5.

c. Chopper Replacement

If a satisfactory operation is not obtained by replacing

tubes, a replacement chopper should be tried. If the new chopper does not clear the difficulty, place the original chopper back in socket. The calibration accuracy must be re-checked and adjusted, if necessary.

d. Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of tubes or chopper, as described previously,it is advisable to make a systematic check of AC voltage, DC voltage, and resistance at each socket pin. Table I shows the nominal AC and DC voltages to ground from each socket pin number. Table II shows the nominal resistance values ecpected for each point. Large or erratic deviations from the listed values of voltage or resistance will serve as a valuable clue in tracking down a faulty component. Once the trouble has been found and corrected, the calibration must be re-checked and re-adjusted as outlined in paragraph 5.3 and paragraph 5.5.

5.5 Calibration Adjustment Procedure

Before making any calibration adjustments, it is essential to provide the necessary reference standards as described in paragraph 5.1 and take all precautions as outlined in paragraph 5.2. The calibration adjustment procedure shall then be made as outlined in Table III.

TABLE I

VOLTAGE MEASUREMENTS

Conditions:

117V 60∿ line input.

VTVM used for all measurements.

All measurements to chassis unless otherwise noted.

Input .01V at any frequency between 100 KC and 1 MC.

Use Ballantine Model 314 VTVM for all AC voltage measurements.

Pin #		1	2	3	4	5	6	7	8	9	10	11
Tube	DC	78	0	.83	53	53	95	0	.9	46	-	-
V1 BEC 525001	AC	2.5mv	1.5mv				.14V	2.5mv			-	-
	DC	.82	2	59	53	30	45	2	-	-	-	-
V2 (6AU6)	AC	.076V				.86V						
	DC	135		2.3	53	53	250	53	74	53	-	-
V3 (12AT7)	AC	27V	.76V					25V	25V		-	-
	DC			53	53			300				
V4 (6X4)	AC	235					235					
	DC	150				150						
V5 (OA2)	AC											
	DC	53	53			53		150	250	0	46	59
11 Pin socket	AC											
	DC											
Chopper Socket	AC			1.5 mv								
					DC 12.6V							
Pin 10 to Pin 11 of 11 Pin Socket					AC .36V							
					DC 6.3V							
Pin 10 to Pin 5 of 11 Pin Socket					AC .015V							

TABLE II

RESISTANCE MEASUREMENTS

Conditions:

Power turned off.

Tubes in sockets, chassis interconnected (11 Pin), all measurements to chassis.

Pin #	1	2	3	4	5	6	7	8	9	10	11
Tube											
V1 BEC 525001	1M	6.8M	11K	16K	16K	500K	2.2M	6.8K	16K	-	-
V2 (6AU6	2.5M	3.8K	16K	16K	500K	1M	3.8K	-	-	-	-
V3 (12AT7)	135K	1M	2.2K	18K	18K	55K	500K	18.5K	18K	-	-
V4 (6X4)	300	-	19K	19K	-	300	50K	-	-	-	-
V5 (OA2)	50K	0	-	0	50K	-	0	-	-	-	-
11 Pin Conn.	19K	19K	-	-	17K	-	45K	60K	0	16K	16K

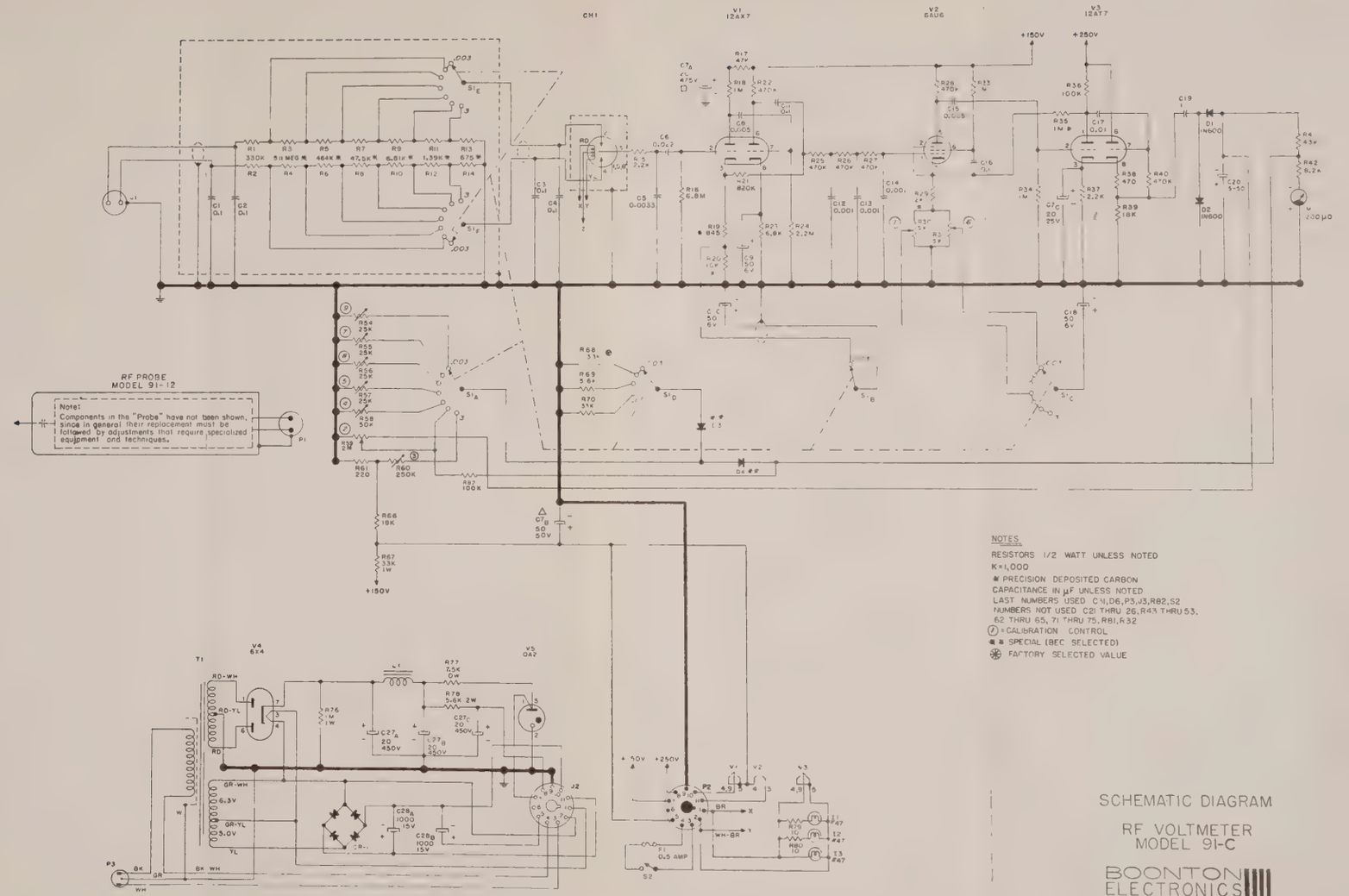
91C

TABLE III

CALIBRATION ADJUSTMENT PROCEDURE

Step	Ref.Std. Voltage	Volt.Range 91C	ADJ No.	Adjust To Read	Notes
1.	.3	1	1	.3	Main gain adjustment: affects down scale readings all ranges 3V to .1V.
2.	.9	1	2	.9	Slope adjustment: affects up scale readings more than down scale: 1V range only.
3	2.5	3	3	2.5	Slope adjustment: affects up scale readings more than down scale: 3V range only.
4	.25	.3	4	.25	Slope adjustment: affects up scale readings more than down scale: 3V range only
5	.09	.1	5	.09	Slope adjustment: affects up scale readings more than down scale: .1V range only.
6	.003	.01	6	.003	Main gain adjustment:affects down scale readings all ranges: .03V to 003V:
7	.009	.01	7	.009	Slope adjustment: affects up scale readings more than down scale: .01 range only.
8	.025	.03	8	.025	Slope adjustment: affects up scale readings more than down scale: .03 range only.
9	.0025	.003	9	.0025	Slope adjustment: affects up scale readings more than down scale: .003V range only.

NOTE: Adjustment #1 to 6 are located from front to rear on right side of cabinet.
Adjustment #7 to 9 are located from rear to front on left side of cabinet.



SCHEMATIC DIAGRAM

RF VOLTMETER
MODEL 91-C

BOONTON ELECTRONICS CORPORATION

830,082 G

WARRANTY

Boonton ELECTRONICS Corporation guarantees to the original purchaser that each instrument it manufactures is free from defects in material and workmanship for a period of one year after date of initial shipment. Our liability is limited to repairing or replacing any defective part with the exception of vacuum tubes, panel lamps, fuses, and batteries. The warranty lapses if, upon our examination, we judge that the instrument has been abused in any way.

PROCEDURE TO FOLLOW WHEN INSTRUMENT IS DEFECTIVE

1. Call our plant or our representative nearest you. A simple solution may result from discussion of the problem with our trained personnel.
2. If the fault is not readily eliminated, prepare the instrument for return to us. Pack carefully in a sturdy container using several inches of shock absorbing material on all six sides of the instrument. Include all probes, cables or accessory units. On all paper work pertaining to the returned instrument, note the model and serial number and state briefly the details of the fault. Ship to us transportation charges prepaid.
3. If the instrument is within the warranty, we will repair and return to you transportation charges prepaid. If the instrument is beyond the one year warranty period, we will repair and return it unless approval on a cost estimate is requested. If the instrument is within the one year warranty period, but our examination reveals abuse, we will await approval of our cost estimate before proceeding with repairs.

PARTS LIST

FOR 91C

Reference		Description		BEC Part No.
C1	Capacitor, Mylar	0.1 µf	200V	230,116
C2	" Mylar	0.1 µf	200V	230,116
C3	" Mylar	0.1 µf	200V	230,116
C4	" Mylar	0.1 µf	200V	230,116
C5	" Mylar	0.0033 µf	200V	230,119
C6	" Mylar	0.022 µf	200V	230,101
C7a	" Elect.	20 µf	475V	283,109
C7b	" Elect.	50 µf	50V	
C7c	" Elect.	20 µf	25V	
C8	" Mylar	0.005 µf	200V	230,121
C9	" Elect.	50 µf	6V	283,112
C10	" Elect.	50 µf	6V	283,112
C11	" Mylar	0.1 µf	200V	230,116
C12	" Mica	1000 µµf	500V	201,143
C13	" Mica	1000 µµf	500V	201,143
C14	" Mica	1000 µµf	500V	201,143
C15	" Mylar	0.005 µf	200V	230,121
C16	" Mylar	0.1 µf	200V	230,116
C17	" Mylar	0.01 µf	300V	230,120
C18	" Elect.	50 µf	6V	283,112
C19	" Met.Paper	1.0 µf	200V	230,104
C20	" Met.Paper	5.0 µf	50V	283,143
C27a,b,c	" Elect.	20-20-20 µf	475V	283,113
C28a,b	" Elect.	1000-1000 µf	15V	283,114
CH-1	Chopper	Bristol		540,108
CR-1	Rectifier,Sel.	Sarkes Tarzian #304B		432,001
D1	Diode	1N600		530,008
D2	Diode	1N600		530,008

Reference		Description	BEC Part No.
D3	Diode	STC135	530,040*
D4	Diode	STC135	530,040*
F1	Fuse	AGC 0.5 Amp	545,502
I1	Lamp	#47	545,101
I2	Lamp	#47	545,101
I3	Lamp	#47	545,101
J1	Receptacle	Amphenol 80-PC-2FT	479,119
J2	Socket	Amphenol 77-MIP-11	472,101
J3	Receptacle	Amphenol UG-290/U	479,107
L1	Choke	Stancor #C1707 7HY	440,001
M1	Meter	Special 0-200 μa	554,139
P1	Plug (Input Cable)	Amphenol 80-MC-2M	479,101
P2	Plug (Amplifier)	Amphenol 86-PM11-11	477,105
P3	Plug & Adapter	P/O AC Line cord	568,101
R1	Resistor, Comp.	330K 1/2W 5%	301,147
R2	"	330K 1/2W 5%	301,147
R3	" Dep.Car.	5.11 Meg. 1/2W 1%	306,788
R4	" " "	5.11 Meg. 1/2W 1%	306,788
R5	" " "	464K 1/2W 1%	306,558
R6	" " "	464K 1/2W 1%	306,558
R7	" " "	47.5K 1/2W 1%	306,440
R8	" " "	47.5K 1/2W 1%	306,440
R9	" " "	6.81K 1/2W 1%	306,339
R10	" " "	6.81K 1/2W 1%	306,339
R11	" " "	1.39K 1/2W 1%	306,694
R12	" " "	1.39K 1/2W 1%	306,694
R13	" " "	675Ω1/2W 1%	306,695
R14	" " "	675Ω1/2W 1%	306,695
R15	" Comp.	2.2K 1/2W 5%	301,095

Reference		Description	BEC Part No.
R16	Resistor,Comp.	6.8 Meg. 1/2W 5%	301,179
R17	" "	47K 1/2W 10%	301,023
R18	" "	1 Meg. 1/2W 10%	301,031
R19	" Dep.Car.	845Ω1/2W 1%	306,231
R20	" " "	10K 1/2W 1%	306,359
R21	" Comp.	820K 1/2W 5%	301,157
R22	" "	470K 1/2W 10%	301,029
R23	" "	6.8K 1/2W 5%	301.107
R24	" "	2.2 Meg. 1/2W 10%	301,033
R25	" "	470K 1/2W 10%	301,029
R26	" "	470K 1/2W 10%	301,029
R27	" "	470K 1/2W 10%	301,029
R28	" "	470K 1/2W 10%	201,029
R29	" Dep.Car.	2K 1/2W 1%	206,279
R30	" " "	2K 2W 20% (1) ADJ	311,114
R31	" " "	2K 2W 20% (6) ADJ	311,114
R32	" " "	845Ω1/2W 1%	306,231
R33	" Comp.	1 Meg. 1/2W 10%	301,031
R34	" "	1 Meg. 1/2W 10%	301,031
R35	" Dep.Car.	1 Meg. 1/2W 1%	306,598
R36	" Comp.	100K 1/2W 10K	301,025
R37	" "	2.2K 1/2W 5%	301,095
R38	" "	470Ω1/2W 5%	301,079
R39	" "	18K 1/2W 5%	301,117
R40	" "	470K 1/2W 10%	301,029
R41	" "	43K 1/2W 5%	301,126
R42	" "	8.2K 1/2W 5%	301,109
R47-R53	(not used)		
R54	" Variable	25K 2W 20% (9) ADJ	311,115
R55	" "	25K 2W 20% (7) ADJ	311,115
R56	" "	25K 2W 20% (8) ADJ	311,115

	Reference		Description		BEC Part No.
R57	Resistor Variable		25K 2W 20%	5 ADJ	311,115
R58	"	"	50K 2W 20%	4 ADJ	311,163
R59	"	"	2 Meg. 2W 20%	2 ADJ	311.195
R60	"	"	250K 2W 20%	3 ADJ	311.103
R61	"	Comp.	200Ω 1/2W 5%		301,071
R66	"	"	18K 1/2W 5%		301,117
R67	"	"	33K 1W 5%		302,137
R68	"	"	3.3K 1/2W 5%		301,099
R69	"	"	5.6K 1/2W 5%		301,105
R70	"	"	33K 1/2W 5%		301,123
R76	"	"	1 Meg. 1W 20%		302,128
R77	"	W.W	7.5K 10W 5%		312,100
R78	"	"	5.6K 2W 5%		304,105
R79	"	Comp.	10Ω 1/2W 5%		301,039
R80	"	"	10Ω 1/2W 5%		301,039
R82	"	"	330K 1/2W 5%		301,147
S1	Switch 6 pole 7 pos. spec. (91C)				466,144
S2	" SPST. Carling #110-63				465,105
T1	Transformer		Power, special		446,007
V1	Elect. Tube		12AX7, special		525,001
V2	Elect. Tube		6AU6		526,6AU6
V3	Elect. Tube		12AT7		526,12AT7
V4	Elect. Tube		6X4		526,6X4
V5	Elect. Tube		OA2		526,OA2

Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty.

SHIPPING INSTRUCTIONS

If it becomes necessary to ship the instrument, the following steps should be followed:

a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in fibreboard carton large enough to permit three inches of soft packing material between instrument and sides of box.

b. Alternatively Boonton Electronics will provide an appropriate shipping container and packing materials at nominal cost. These may be obtained by writing to the Sales Department, Boonton Electronics Corporation, Route 287 at Smith Rd., Parsippany, N. J. 07054.

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